EEE 322

EXPERIMENT # 5

VEE CURVES OF SYNCHRONOUS MACHINES

1. THE OBJECT OF THE EXPERIMENT

The object of the experiment is to obtain the Vee-curves of a synchronous machine after synchronizing it onto a three phase bus bar while it is operating as a synchronous motor.

2. THEORY

VEE CURVES OF A SYNCHRONOUS MOTOR

The equivalent circuit of a synchronous motor operating on an infinite bar is shown in Fig.1(a) and corresponding phasor diagram is given in Fig.1(b).

Where E and V are phase voltages,

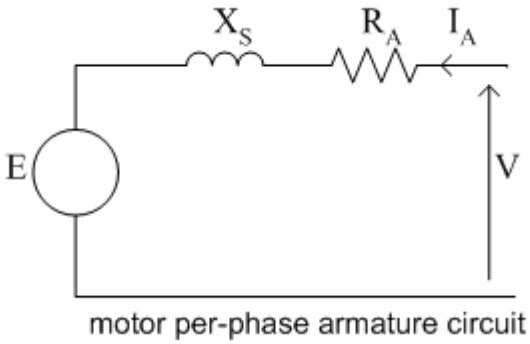

Fig.1(a) Equivalent circuit a synchronous motor operating on an infinite bus bar

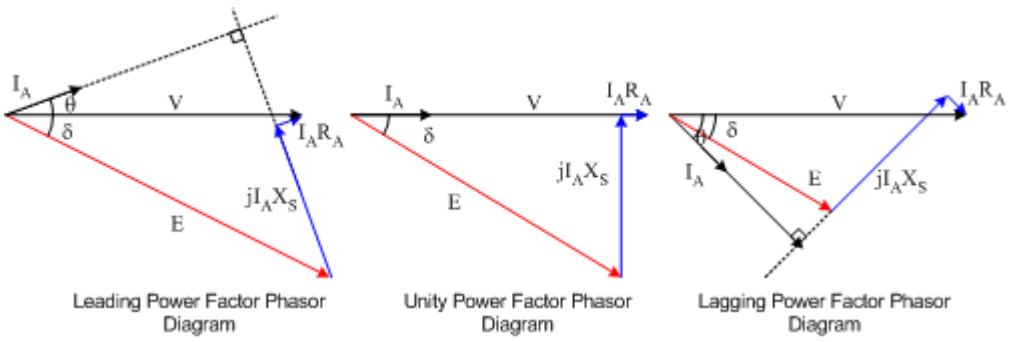

Fig.1(b) Phasor diagram of the synchronous diagram

Now, assume that a constant shaft load is applied to the motor and also assume that the synchronous impedance Zs is constant. Then the equations above can be properly combined

to obtain a relation between the excitation emf, E and armature current I_A. This relation can further be converted to a relation between I_A and field current, If using the open-circuit curve of the machine. Although the major allowance for saturation is made using the O.C.C. curve, some error is introduced due to the assumption of constant Zs.

A typical set of curves of armature current against field current for various constant shaft loads is shown in Fig.2.

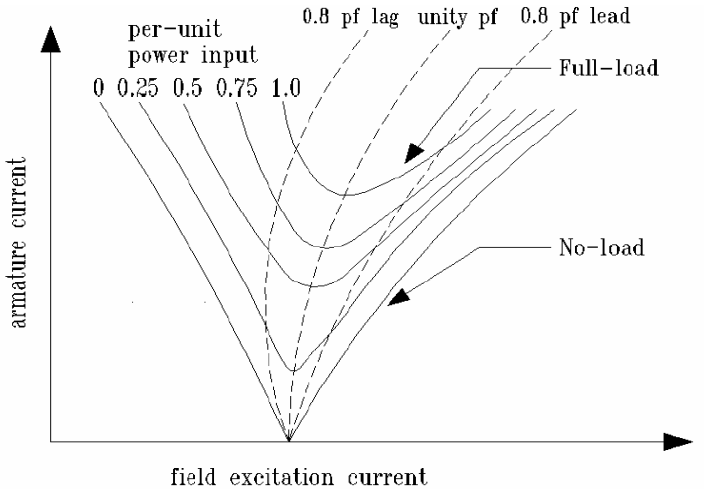

Fig.2 Typical V-curves of a synchronous motor

3. EXPERIMENTAL WORK

1. Connect the circuit as shown in Fig.3 start the dc driving motor and adjust its speed to a value close to that of synchronous machine. Switch on the three-phase supply and adjust the three-phase variac until the line to line voltage across the supply terminals (L1,L2,L3) of the synchronizing switch is equal to the rated value of the synchronous machine. Slowly increase the field current of the synchronous machine using single-phase variac until the line to line voltage across the machine terminal of the synchronizing switch is equal that of the supply terminals. Check the phase-sequence of the voltages at the machine and supply terminals of the synchronizing switch using a phase-sequence of each side is not the same, switch off the three-phase supply and interchange the two phases of the supply.

Connect a straight-connected bulb-type synchroscope across the synchronizing switch S2 synchronize both side of the synchronizing switch (close the synchronizing switch when the bulb is off).

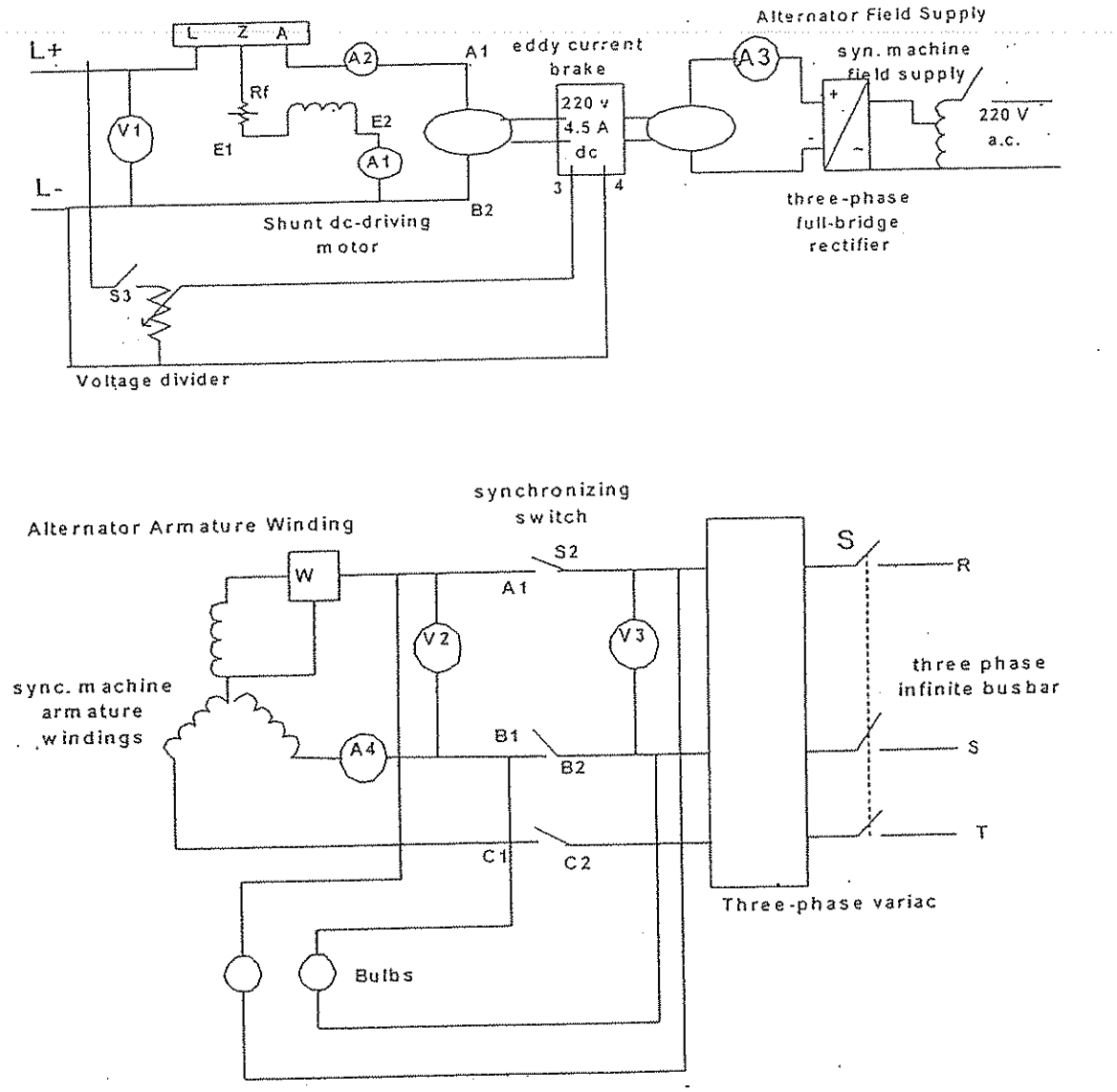

Figure 3 Experimental setup

2. After synchronizing synchronous motor, stop the dc motor using the starter. Now the synchronous machine runs as a synchronous motor. Under the supervision of the assistant, reduce the field current of the synchronous motor until the motor begins the loss synchronism this may be observed with aid of the stroboflash. Increase field current until synchronism is just regained. Note that the motor may not in fact loss synchronism under conditions of light load under this conditions the armature current of the synchronous motor should not be allowed to exceed a value 10% greater than the rated value. Now, increase the field current in steps, recording at each step the value of field current, armature current and the reading of wattmeter.

3. Close switch S3.Adjust the eddy-current brake using the voltage divider circuit, until the output power delivered 50% that of the synchronous motor.

Repeat the procedure described in 2 and 3 above with the output power fixed at this value.

4. Repeat the procedure described in 2 and 3 for 75% of the rated output power of synchronous motor.
5. Repeat the procedure described in 2 and 3 for full load of rated output power of the synchronous motor.

1. RESULTS AND CONCLUSIONS

1. Calculate the input power and power factor of the synchronous motor at all points of operation used in the test.
2. Convert all measured quantities to their per unit values.
3. Plot the Vee curves of the synchronous motor and lines of the constant power factor.
4. Comment on the shape of the characteristics obtained and explain why for a constant output power there is a small increase in input power as the field current is increased

Table of results for C2.

If(A)							
IA(A)							
W(w)							

Table of results for C3.

IA(A)							
W(w)							

Table of results for C4.

If(A)							
IA(A)							
W(w)							

Table of results for C5.

If(A)							
IA(A)							
W(w)							

EQUIPMENT

1 Voltmeter 0-260 V(V1)
2 Voltmeter 0-520 V(V2-V3)
2 Ammeters 0-1.2 A(A1-A3)
1 Ammeter 0-30 A(A2)
1 Ammeter 0-1.2 A(A4)
1 Wattmeter 0-10 A,240 V
1 Phase sequence indicator
1 Synchroscope
1 Rheostat
V.D.C(Voltage Divider Circuit)

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